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1) An aircraft in level and unaccelerated flight with a velocity of v_∞ = 300 m/s requires a power of $9 \times 10^6 W$. If the aircraft weighs $1.5 \times 10^5 N$, the lift-to-drag ratio $\frac{L}{D}$ is __________.
2) The percentage change in the lift-off distance for a 20 % increase in aircraft weight is __________.
3) Consider a monoplane wing and a biplane wing with identical airfoil sections, wingspans and incidence angles in identical conditions in a wind tunnel. As compared to the monoplane, the biplane experiences
   a) a higher lift and a higher drag
   b) a higher lift and a lower drag
   c) a lower lift and a lower drag
   d) a lower lift and a higher drag
4) A statically stable trimmed aircraft experiences a gust and the angle of attack reduces momentarily. As a result, the center of pressure of the aircraft
   a) shifts forward
   b) shifts rearward
   c) does not shift
   d) coincides with the neutral point
5) Consider a wing of elliptic planform, with its aspect ratio $AR \to \infty$. Its lift-curve slope, $\frac{dC_L}{d\alpha}$ = __________.
6) An ideal gas in a reservoir has a specific stagnation enthalpy of h_0. The gas is isentropically expanded to a new specific stagnation enthalpy of $\frac{h_0}{2}$ and velocity u. The flow is one-dimensional and steady. Then $\frac{u^2}{h_0}$ = __________.
7) The Reynolds number, Re is defined as $\frac{U_\infty L}{v}$ where L is the length scale for a flow, U_∞ is its reference velocity and v is the coefficient of kinematic viscosity. In the laminar boundary layer approximation, comparison of the dimensions of the convection term $u\frac{\partial u}{\partial x}$ and the viscous term $v\frac{\partial^2 u}{\partial x^2}$ leads to the following relation between the boundary layer thickness δ and Re
   a) $\delta \propto \sqrt{Re}$
   b) $\delta \propto 1/\sqrt{Re}$
   c) $\delta \propto Re$
   d) $\delta \propto 1/Re$
8) Isentropic efficiencies of an aircraft engine operating at typical subsonic cruise conditions with the following components - intake, compressor, turbine and nozzle - are denoted by η_i, η_c, η_t and η_n, respectively. Which one of the following is correct?
   a) $\eta_i < \eta_c < \eta_t < \eta_n$
   b) $\eta_t < \eta_i < \eta_c < \eta_n$
   c) $\eta_c < \eta_t < \eta_i < \eta_n$
   d) $\eta_c < \eta_i < \eta_t < \eta_n$
9) A rocket nozzle is designed to produce maximum thrust at an altitude, $H = 8km$ from the sea level. The nozzle operates in
   a) under-expanded condition for $H > 8km$
   b) under-expanded condition for $H < 8km$
   c) sonic exit condition for $H < 8km$

d) unchoked condition for $H < 8km$

10) In the solution of $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = 0$, if the values of the integration constants are identical and one of the initial conditions is specified as $y(0) = 1$, the other initial condition $y'(0) =$ __________.

11) For $x > 0$, the general solution of the differential equation $\frac{dy}{dx} = 1 - 2y$ asymptotically approaches __________.

12) For a parabola defined by $y = ax^2 + bx + c$, $a \neq 0$, the coordinates (x, y) of the extremum are

a) $\left(\frac{-b}{2a} + \frac{\sqrt{b^2-4ac}}{2a}, 0\right)$
b) $\left(\frac{-b}{2a}, \frac{-b^2+4ac}{2a}\right)$
c) $\left(\frac{-b}{2a}, \frac{-b^2+4ac}{4a}\right)$
d) $(0, c)$

13) The 2-D stress state at a point P in the x-y coordinate system is $\begin{bmatrix} 60 & 50 \\ 50 & -40 \end{bmatrix} MPa$. The magnitude of the tangential stress (inMPa) on a surface normal to the x- axis at P is __________.